UNIVERSITI TEKNOLOGI MARA

JIIICaS 2024
JOHOR INTERNATIONAL INNOVATION, INVENTION COMPETITION AND SYMPOSIUM

PROCEEDINGS OF JOHOR INTERNATIONAL INNOVATION INVENTION COMPETITION AND SYMPOSIUM 2024 (JIIICaS 2024)

"Flourish and Nurturing Sustainable Innovation for a Prosperous Nation"

JIICOS 2024
JOHOR INTERNATIONAL INNOVATION, INVENTION COMPETITION AND SYMPOSIUM

Editorial Board

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Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor International Innovation Invention Competition and Symposium 2024 (JIIICaS2024), where JIIICaS2024 is a virtual platform for all creative minds to share and present their invention and innovation. Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students and get some ideas to develop future innovation products.

Foreword Rector

Assalamualaikum warahmatullahi Wabarakatuh, Salam Sejahtera, Salam Malaysia MADANI and Salam UiTM Dihatiku.

In the name of Allah, the Most Gracious, the Most Merciful.

It is a great honor to welcome you to the Johor International Innovation, Invention, Competition, and Symposium 2024 (JIIICaS 2024). This event connects various disciplines, focusing on education and engaging educators, students, researchers, and innovators from all walks of life.

Innovation is not just about ideas; it demands perseverance, creativity, and determination to turn those ideas into reality. The remarkable projects showcased today highlight the dedication and spirit of all participants. Initiatives like this not only explore new technologies but also cultivate skills and leadership among our youth. At Universiti Teknologi MARA (UiTM) Johor Branch, we are fully committed to fostering a dynamic culture of innovation, promoting the commercialization of new products, and encouraging meaningful collaborations with industry and society.

As we celebrate this event, I would like to extend my heartfelt gratitude to all sponsors, judges, the College of Computing, Informatics and Mathematics, UiTM Pasir Gudang Campus as the event organizer, as well as to the researchers and participants for their hard work in making this event a success. Let us continue striving for innovation and excellence. May the ideas presented today inspire us and lay the groundwork for future achievements.

Thank you.

Associate Professor Dr. Saunah Zainon
Rector
Universiti Teknologi MARA (UiTM)
Johor Branch

(A-ST023) IoT ALARM SYSTEM: DETECTING & PREVENTING MICROSLEEP EVENTS

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ABSTRACT

Microsleep events while driving pose a significant risk for road accidents. To address this issue, this project proposed an Internet of Things (IoT)-enabled anti-microsleep alarm system for drivers. The system features a Node-Red, Mongo DB and Slack API that is equipped with sensors, a gauge dashboard to monitor driver physiology in real-time, including EAR and Lips Distance, notifications for the driver, voice out alarm with eSpeak, MongoDB for showing timestamp of the driver for yawn and drowsiness. The sensor data is transmitted to an onboard alarm unit that employs machine learning algorithms to analyze the metrics and detect early signs of microsleep episodes. Once the algorithms calculate a drowsiness score exceeding a defined threshold, multi-modal alarms encompassing auditory, visual, and tactile feedback are activated to alert the driver and prompt preventive actions before microsleep commences. The system is designed to be adaptive and customizable based on driver preferences and changing road conditions, allowing for improved detection accuracy and minimal distraction. This project aims to leverage recent advances in IoT and sensor technologies to introduce an intelligent microsleep alarm unit that can significantly enhance road safety by addressing a major yet often overlooked factor in driver fatigue. One of the most important aspects of the project is the integration with the Message Queuing Telemetry Transport (MQTT) protocol, enabling seamless communication and data exchange between the Python-based microsleep alarm system and the Node-RED platform. Node-RED, a powerful visual programming tool used for developing IoT applications, facilitated the creation of an intuitive and informative dashboard.

Keywords: Microsleep Detection, Road Safety, IoT

1.0 INTRODUCTION

Driver fatigue causes hundreds of car accidents annually. Drivers' capacity to use essential sensory input for safe vehicle operation is impaired by microsleep episodes, which cause brief loss of awareness. Researchers are working harder to identify solutions due to wearable tech and the IoT. Unobtrusive wearables with physiological sensors provide real-time driver drowsiness monitoring. The physiological characteristics analysed include eyelid closure, head position, HRV, brain activity, and more. Machine learning systems can detect microsleep and early-onset tiredness using sensor readout anomalies. IoT connectivity allows drivers to receive alerts for problematic states quickly. A compact, wearable headband with strain gauge sensors and a panic button is novel and promising. Strain sensors detect abrupt muscle tension reductions during microsleep. Detecting microsleeps in a driving simulator, the alert activates 0.96 seconds after each episode begins. Driver fatigue and microsleeps cause road accidents; IoT devices that respond rapidly could greatly

minimise them. Increasing sensor hardware and 5G infrastructure can help commercialise products.

2.0 PROJCT OBJECTIVES

The project aims to achieve two primary objectives: First, to develop and deploy a customizable anti-microsleep alarm system that leverages Internet of Things (IoT) technologies and real-time algorithms to detect and prevent drowsy driving. This system will utilize an array of sensors, including eye tracking modules and facial recognition cameras, to monitor physiological signs of fatigue and deliver timely multi-modal alerts to the driver. Second, to ensure that the system is adaptable and tailored to individual drivers' needs, the project will incorporate advanced machine learning algorithms and customizable alert mechanisms. By integrating wearable sensors, IoT connectivity, and real-time data processing, the system seeks to provide effective, personalized interventions that enhance road safety and reduce the risk of accidents caused by microsleep.

3.0 PROJECT METHODOLOGY

The Flowchart of this project that shown in Figure 1.

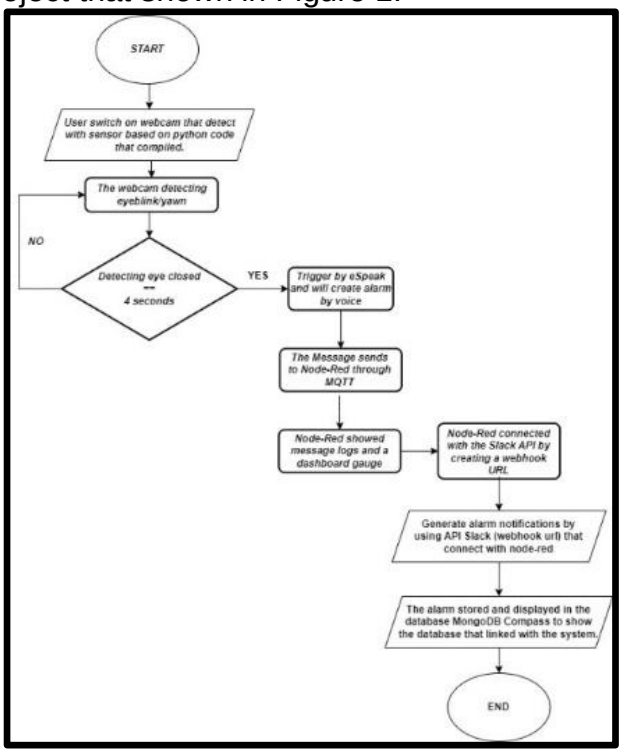

Figure 1: Project Flowchart

Table 1: Stages of Project Methodology

STAGES	TASKS	DELIVERABLES
Planning	• Define problem and objectives. • Review literature.	• Clear problem statement, scope, objective.
Design	• Create logical design. • Create a user-friendly interface for users.	• Detailed schematic diagram and user-friendly interface design.
Development	• Follow coding guidelines with libraries & dependencies of python. • Install Software such as VScode, Python, MQTT, Node-Red, Slack API and MongoDB.	• Fully coded system, established database with MongoDB that show alarm status and timestamp, and functional dashboard with notifications using Node-red with link of MQTT.
Evaluation	• Test the integration sensor with webcam and access system sensor by notifications.	• A flexible webcam sensor system that integrates with dlib, OpenCV with low-latency data processing.

Figure 2 highlights the structured development environment and adherence to coding standards in the project. It illustrates the use of essential dependencies and libraries, notably OpenCV and dlib, which are pivotal for facial recognition and landmark identification, thus facilitating the accurate detection of fatigue indicators. Key metrics such as the Eye Aspect Ratio (EAR) and lips distance were utilized to assess gaping and fatigue in real-time video data. The implementation involved a comprehensive feedback loop for monitoring, the MQTT protocol for efficient communication between the Python system and Node-RED, and a range of additional components including the Slack API for notifications, MongoDB for data storage, and eSpeak for aural alerts. The summary, as depicted in Figure 3, underscores the successful integration of these technologies for real-time fatigue detection, outlines the challenges faced, and emphasizes the need for enhanced data aggregation and filtering methods. This chapter provides significant insights into the practical application and potential improvements of the technology.

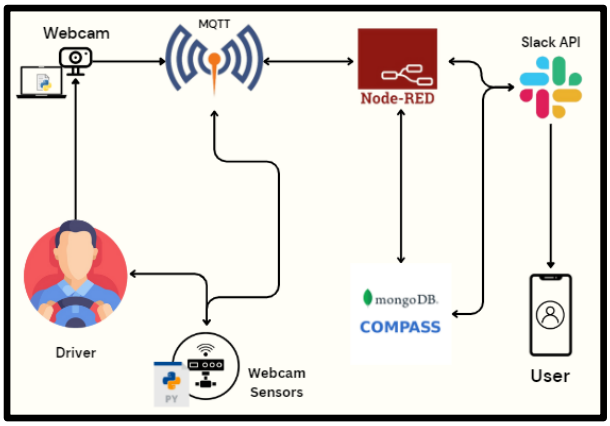

Figure 2: Project Logical Design

5.0 RESULTS

A development environment and coding standards were established to create a microsleep detection system, with Python being employed due to its adaptability. The system utilized OpenCV, dlib, and Haar Cascade for facial recognition, analyzing real-time video to identify indicators of drowsiness and yawning by calculating EAR (Eye Aspect Ratio) and Lips Distance which focusing on detecting face using face landmark x68. To facilitate communication and establish an intuitive interface for real-time monitoring, the project integrated MQTT and Node-RED. Stakeholders were informed of the potential for driver fatigue through the Slack API. The anti-microsleep alarm system, which is based on the Internet of Things (IoT), provides notable benefits such as continuous monitoring in real-time and exceptional precision. The technology employs continuous facial expression tracking of drivers to identify indications of weariness, facilitating prompt intervention to avert accidents. The system achieves a high level of accuracy in identifying prolonged eye closure and yawning by utilising advanced libraries such as OpenCV, dlib, and Haar Cascade for facial recognition, as seen in Figure 3.

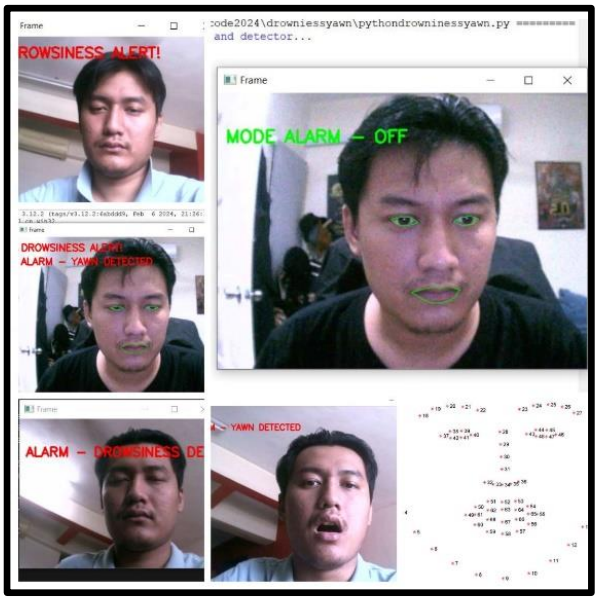

Figure 3: Sample Output from Webcam

The anti-microsleep warning system, which utilises IoT technology, includes a user-friendly dashboard created with Node-RED. This dashboard offers a clear and real-time presentation of Eye Aspect Ratio (EAR) and lip distances. The user-friendly interface facilitates effortless monitoring and enables prompt reactions to indications of driver weariness, as depicted in Figure 4.

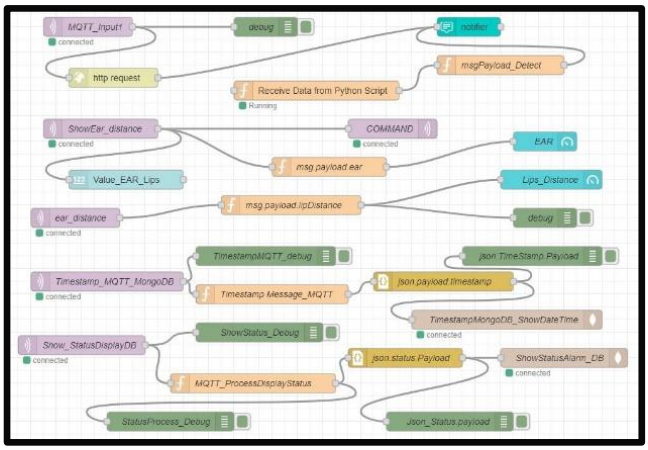

Figure 4: Node-Red Flow Map Linking with MQTT, Python and Slack API

The IoT-based anti-microsleep alert system has a significant impact, especially in improving traffic safety. The system's ability to identify tiredness in its early stages is essential for reducing accidents caused by microsleep, thus enhancing driving safety. In addition, the system's real-time alerts and notifications, which are sent through Slack, allow fleet managers to monitor the vigilance and safety of several drivers at the same time, as shown in Figure 5.

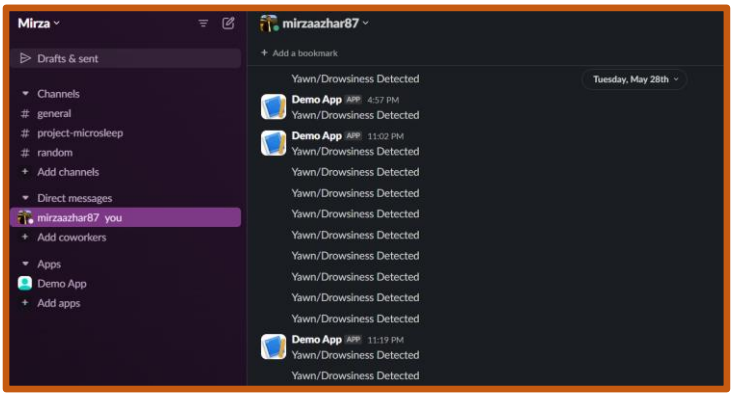

Figure 5: Notifications from Slack API

The findings from the IoT-based anti-microsleep alert system demonstrate its efficacy and dependability. Through the testing process, the system effectively identified occurrences of driver weariness and yawning, thereby demonstrating its proficiency in real-life situations. In addition, the system exhibited strong performance, consistently retaining precision and dependability in various driving circumstances. The IoT-based anti-microsleep alarm system stands out for its novel integrated approach to driver monitoring. By combining Python for development, OpenCV for image processing, and Node-RED for dashboard creation, the system offers a unique and innovative solution. Additionally, the integration of the MQTT protocol and Slack API for real-time alerts significantly enhances the system's utility and responsiveness, making it a cutting-edge tool for preventing microsleep-related accidents.

5.0 CONCLUSION

In conclusion, the IoT Anti-Microsleep Alarm for Drivers project successfully achieved its objectives of enhancing road safety by monitoring driver attentiveness and detecting fatigue. The project utilized advanced technology for real-time monitoring and alarm systems, employing facial landmark detection to monitor eye and mouth movements, which are key indicators of drowsiness and yawning. The system leveraged the MQTT protocol for efficient communication and integrated open-source tools like Node-RED and Slack API for data handling and notifications. Despite its success, the project acknowledges limitations in scalability and integration, necessitating ongoing improvements.